

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

Appl. No. : **10/706,645**

Confirmation No. : **7027**

Applicant(s) : **Charles R. Rapier et al.**

Examiner : **Paul A. Wartalowicz**

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Docket No.: **1856-42801 (40183)**

Customer No.: **31889**

For: **Stabilized Alumina Supports, Catalysts Made Therefrom, and Their Use In  
Partial Oxidation**

**APPEAL BRIEF UNDER 37 C.F.R. § 41.37**

Mail Stop Appeal Brief – Patents

Date: **July 27, 2007**

Commissioner for Patents  
P. O. Box 1450  
Alexandria, VA 22313-1450

Sir:

This *Appeal Brief* is filed concurrently with the payment of the \$500 fee required under 37 C.F.R. § 41.20(b)(2) pursuant to the *Notice of Appeal* which was filed on March 28, 2007 with a *Request for Pre-Appeal Conference*. This is an appeal from the *Final Office Action* dated November 28, 2006 and further from the *Advisory Action* dated February 27, 2007.

In the *Notice of Panel Decision from the Pre-Appeal Brief Conference* dated April 24 2007, the time period for filing the *Appeal Brief* which was set to the balance of the two-month time period running from the receipt of the *Notice of Appeal* ended on May 28, 2007. Appellants request a two-month extension by submitting herewith a Petition for Extension of Time (PTO/SB/22) and the corresponding fee payment (\$450) to extend the time period to July 30, 2007 (July 28 being a Saturday). As such, the filing of this *Appeal Brief* is deemed timely.

Should any other fees have been inadvertently omitted, or if any additional fees are required or have been overpaid, please appropriately charge or credit those fees to **Deposit Account Number 16-1575**, and if necessary, please consider this submission as a petition for an additional extension of time and charge any necessary fees that may be due for this extension to the Deposit Account listed above.

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**I. REAL PARTY OF INTEREST**

The real party of interest of the above-identified patent application is **ConocoPhillips Company** by virtue of an assignment from six of the seven co-inventors recorded in the U.S. Patent and Trademark Office on March 15, 2004 at **Reel No. 015070, Frame No. 0571**, and an assignment from a seventh co-inventor recorded in the U.S. Patent and Trademark Office on August 29, 2005 at **Reel No. 016463, Frame No. 0927**. ConocoPhillips Company is a corporation organized and existing under the laws of State of Delaware in the United States of America, and having its main office at 600 North Dairy Ashford, Houston, Texas 77079.

**II. RELATED APPEALS AND INTERFERENCES**

There are no appeals, interferences, or judicial proceedings known to Appellants, the Appellants' legal representative, or Assignee, which may be related to, directly affect, be directly affected by, or have a bearing on the decision of the Board of Patent Appeals and Interferences in the pending appeal.

**III. STATUS OF CLAIMS**

Claims 1-9, 11-13, 16-35, 37-40, 42-55, 57, 58, 60-74, 76-81 and 83-90 are pending and are listed in the CLAIMS APPENDIX (VIII).

Of the pending claims, Claims 1-9, 11-13, 16-25, 40, 42-49, 60-74, 76-77, 80-81 and 83-90 were examined and stand rejected. These claims are subject to this appeal.

Claims 26-35, 37-39, 50-55, 57-58, 60-74 and 78-79 stand withdrawn from examination as parts of non-elected inventions as a result of the *Restriction Requirement* of January 25, 2006. Since

the withdrawn claims were not canceled by Appellants, these claims are still pending in the present application.

Appellants note however that withdrawn Claims 26-35, 37-39, 50-55, 57-58, 60-74 and 78-79 (which were not cancelled by Appellants) were not listed under item No. 7 in the *Advisory Action* of February 27, 2007 as "Claims withdrawn from consideration" and further under item No. 2 in the *Notice of Panel Decision from Pre-Appeal Brief Review* of April 24, 2007. These omissions in both documents are erroneous, since the withdrawn Claims 26-35, 37-39, 50-55, 57-58, 60-74 and 78-79 are still pending in the present application.

Although the withdrawn claims are not subject to this appeal, Appellants have requested their rejoinder to the examination of the present application upon allowance of Claims 1 and 40.

Claims 10, 14-15, 36, 41, 56, 59, 75 and 82 were previously canceled from the patent application during examination and are no longer pending.

#### **IV. STATUS OF AMENDMENTS**

Appellants submitted a response and a claim amendment under 37 C.F.R § 1.116 on January 29, 2007 in reply to the *Final Office Action* of November 28, 2006. In an *Advisory Action* mailed on February 27, 2007, Appellants were apprised that the amendment to the claims was entered for purpose of appeal, that the rejection of Claim 40 under 35 U.S.C. §112, second paragraph, for indefiniteness was withdrawn, but that the rejections under 35 U.S.C. §103 were maintained.

As such, the claim listing in the January 29, 2007 amendment is the most current presentation of the pending claims.

**V. SUMMARY OF CLAIMED SUBJECT MATTER**

The claimed subject matter represented by Claims 1, 8, 12, 16, 40, 85, 86, 89 and 90 relates to a high temperature stable catalyst support (Claims 1, 8, 12, 16, 85) and a supported partial oxidation catalyst (Claims 40, 86, 89, 90).

Independent Claim 1 covers a high temperature stable catalyst support (pg. 6, § [0018], lines 30-31) comprising a combination of three crystalline structures: an alumina phase selected from the group consisting of alpha-alumina, theta-alumina and combinations thereof (pg. 7, § [0020], lines 20-21; pg. 8, § [0020]; lines 6-7); a rare earth aluminate of a hexaaluminate or hexaaluminate-like structure comprising at least one rare earth metal and having a high molar ratio of aluminum to rare earth metal between 11:1 and 14:1 (pg. 7, § [0019], lines 11-18; pg. 8, § [0020]; lines 5-6); and a rare earth aluminate of a perovskite or perovskite-like structure comprising the at least one rare earth metal and having a low molar ratio of aluminum to rare-earth metal of less than 2:1 (pg. 11, § [0028], lines 8-10; pg.17, § [0046], lines 1-3), wherein the catalyst support contains less than 100 wt% to about 1 wt% of the rare earth aluminate with the high molar ratio of aluminum to rare earth metal (pg. 7, § [0020], lines 23-26). In addition, the catalyst support contains not more than 20% of alpha-alumina (pg. 19, § [0059], line 28).

For Claim 8 dependent from Claim 1, the rare earth aluminate with the high aluminum to rare-earth metal molar ratio and the alumina phase can be intimately mixed (pg. 17, § [0047], lines 6-7).

For Claim 12 dependent from Claim 1, the rare earth aluminate with the high molar ratio of aluminum to rare-earth metal in the high-temperature catalyst support has a chemical formula of  $MAlyO_z$ , where y is between 11 and 12; z is between 18 and 19; Al and O represent aluminum atoms and oxygen atoms respectively; and M comprises a combination of lanthanum and samarium. (pg. 18, § [0052], lines 1-4 & 9)

For Claim 16 dependent from Claim 1, the stable support may further comprise an oxide of the rare earth metal. (pg. 18, § [0054], lines 13-14)

Independent Claim 40 covers a partial oxidation catalyst (pg. 10, § [0028], lines 24) comprising (a) an active ingredient comprising a rhodium alloy (pg. 23, § [0069], lines 8-9) or a metal selected from the group consisting of rhodium, iridium, ruthenium and combinations thereof (pg. 10, § [0028], lines 24-25; pg. 22, § [0067], lines 23-24; pg. 22, § [0067], lines 23-24). When the active ingredient (a) comprises rhodium, rhodium is in an amount of from about 0.1 wt% to about 20 wt% based on the total catalyst weight (pg. 23, § [0070], lines 21). The partial oxidation catalyst further comprises (b) a support onto which the active ingredient is dispersed, said support comprising an alumina phase selected from the group consisting of alpha-alumina, theta-alumina and combinations thereof (pg. 7, § [0020], lines 20-21; pg. 8, § [0020], lines 6-7; pg. 22, § [0066], lines 14-15); a rare earth aluminate of a hexaaluminate or hexaaluminate-like structure comprising at least one rare earth metal and having a high molar ratio of aluminum to rare earth metal between 11:1 and 14:1 (pg. 7, § [0019], lines 11-18; pg. 8, § [0020], lines 5-6; pg. 22, § [0067], lines 25-27); and a rare earth aluminate of a perovskite or perovskite-like structure comprising the at least one rare earth metal and having a low molar

ratio of aluminum to rare-earth metal of less than 2:1 (pg. 11, § [0028], lines 8-10; pg.17, § [0046], lines 1-3). The catalyst support contains less than 100 wt% to about 1 wt% of the rare earth aluminate with the high molar ratio of aluminum to rare earth metal (pg. 7, § [0020], lines 23-26).

For Claim 85 dependent from Claim 40, the partial oxidation catalyst comprises between about 0.5 wt% and about 10 wt% of rhodium (pg. 23, § [0070], lines 21-22).

Independent Claim 86 covers a partial oxidation catalyst (pg. 22, § [0067], line 23) comprising: (a) an active ingredient comprises rhodium (pg. 10, § [0028], lines 24-25; pg. 22, § [0067], lines 23-24; pg. 22, § [0067], lines 23-24) or a rhodium alloy (pg. 23, § [0069], lines 8-9), in an amount of from 0.1 wt% to about 20 wt% rhodium based on the total catalyst weight (pg. 23, § [0070], lines 21). The rhodium alloy comprises rhodium and a metal selected from the group consisting of ruthenium, iridium, platinum, palladium, tantalum, niobium, molybdenum, rhenium, tungsten, cobalt, and zirconium (pg. 23, § [0069], lines 15-16). The catalyst further comprises (b) a support onto which the active ingredient is dispersed, said support (b) comprising an alumina phase selected from the group consisting of alpha-alumina, theta-alumina and combinations thereof (pg. 7, § [0020], lines 20-21; pg. 8, § [0020], lines 6-7; pg. 22, § [0066], lines 14-15); a rare earth aluminate of a hexaaluminate or hexaaluminate-like structure comprising at least one rare earth metal and having a high molar ratio of aluminum to rare earth metal between 11:1 and 14:1 (pg. 7, § [0019], lines 11-18; pg. 8, § [0020], lines 5-6; pg. 22, § [0067], lines 25-27); and a rare earth aluminate of a perovskite or perovskite-like structure comprising the at least one rare earth metal and having a low molar ratio of aluminum to rare-

earth metal of less than 2:1 (pg. 11, § [0028], lines 8-10; pg.17, § [0046], lines 1-3). The catalyst support contains less than 100 wt% to about 1 wt% of the rare earth aluminate with the high molar ratio of aluminum to rare earth metal (pg. 7, § [0020], lines 23-26).

For Claim 89 dependent from Claim 86, the partial oxidation catalyst comprises between about 0.5 wt% and about 10 wt% of rhodium (pg. 23, § [0070], lines 21-22).

For Claim 90 dependent from Claim 86, the partial oxidation catalyst comprises rhodium and has a rhodium surface area greater than about 0.5 m<sup>2</sup>/g rhodium (§ [0072], pg. 23, line 31 to pg. 24, lines 1-2).

## **VI. GROUNDS OF REJECTIONS TO BE REVIEWED ON APPEAL**

Whether it would have been obvious to a person having ordinary skill in the art to combine U.S. Patent 6,015,285 (hereinafter referred to as *McCarty*) with U.S. Patent 6,830,596 (hereinafter referred to as *Deckman*) and further add U.S. Patent 4,906,176 (hereinafter referred to as *Yamashita*) to arrive at a catalyst support set forth in the Claims 1-11, 13-25, 40-49 & 76-77, and to arrive at a supported catalyst set forth in the Claims 40-49, 80-81 & 83-90;

Whether it would have been obvious to a person having ordinary skill in the art to combining *McCarty* with *Deckman* and *Yamashita* and further add U.S. Patent 4,793,797 (hereinafter referred to as *Kato*) in a manner that would result in a catalyst support set forth in Claim 12.



## **VII. ARGUMENTS**

### **A- Grouping of Claims**

For the purpose of appeal, the claims which Appellants request to review are divided into the following groups:

**Group I:** Claims 1-9, 11, 13, 16-25, 76 and 77 relate to a high-temperature stable catalyst support and are rejected under 35 U.S.C. §103(a) over *McCarty* in view of *Deckman* and *Yamashita*. Claim 1 is the independent claim of this group.

**Group II:** Claims 40, 42-49, 80, 81 and 83-90 relate to a partial oxidation catalyst and are rejected under 35 U.S.C. §103(a) over *McCarty* in view of *Deckman* and *Yamashita*. Claims 40 and 86 are the independent claims of this group.

**Group III:** Claim 12 dependent from Claim 1 relates to a high-temperature stable catalyst support and is rejected under 35 U.S.C. §103(a) over *McCarty* in view of *Deckman*, *Yamashita* and *Kato*.

### **B- Cited references**

#### **McCarty (U.S. Patent No. 6,015,285)**

*McCarty* teaches a process for combustion of fuel in which oxygen-containing gas is mixed with a fuel to form a combustible mixture which is then contacted in a first zone with a first zone combustion catalyst comprising PdO disposed on a support at reaction conditions sufficient to combust a portion of the fuel and produce a first zone combustion catalyst temperature no greater than about 800 °C. The partially combusted fuel from the first zone is then contacted in a second zone with a second zone combustion catalyst. Supports for the first zone combustion catalyst include La<sub>2</sub>O<sub>3</sub>-stabilized gamma-Al<sub>2</sub>O<sub>3</sub>, La-stabilized gamma-Al<sub>2</sub>O<sub>3</sub>, Ce-stabilized gamma-Al<sub>2</sub>O<sub>3</sub>, Ba-

stabilized gamma- $\text{Al}_2\text{O}_3$ , and  $\text{La}_2\text{O}_3$ -11 $\text{Al}_2\text{O}_3$  hexa-aluminate. Second zone combustion catalysts include  $\text{La}_{0.5}\text{Sr}_{0.5}\text{MnAl}_{11}\text{O}_{19}$ , PdO on  $\text{La}_2\text{O}_3$ -11 $\text{Al}_2\text{O}_3$  hexa-aluminate, and  $\text{La}_{0.2}\text{Sr}_{0.8}\text{MnAl}_{11}\text{O}_{19}$  (*McCarty's Abstract*)

The Examiner has indicated that *McCarty* teaches the use of alpha-alumina as a diffusion barrier layer in the catalyst, teaches the combination of a rare earth hexaaluminate and stabilized alumina as a support for the first combustion zone, and teaches the use of a rare earth hexaaluminate or a rare earth aluminate perovskite as individual support to carry the combustion active metal.

**Deckman (U.S. Patent No. 6,830,596)**

*Deckman's* invention is directed to a heat exchanged membrane reactor for electric power generation. More specifically, the invention comprises a membrane reactor system that employs catalytic or thermal steam reforming and a water gas shift reaction on one side of the membrane, and hydrogen combustion on the other side of the membrane. (*Deckman's Abstract*)

According to the Examiner, *Deckman* teaches the combination of a rare earth hexaaluminate and a rare earth aluminate perovskite as a support for a combustion catalyst. *Deckman* is further said to teach the combination of alumina, a rare earth hexaaluminate and a rare earth aluminate perovskite as a membrane component.

**Yamashita (U.S. Patent No. 4,906,176)**

*Yamashita* is concerned with a high temperature stable catalyst comprising an alumina base support and a catalytically active component supported on the support, as well as a process for preparing the catalyst and a process for conducting chemical reactions such as steam reforming, desulfurization of heavy oil, cracking of hydrocarbons, etc. using the catalyst. The support is featured by its specific composite oxide having a specific surface area of at least  $10 \text{ m}^2/\text{g}$  and a structural form

of amorphous state or a phase resemble to lanthanoide beta-alumina. The composite oxide can be converted to lanthanoide beta-alumina when heated to an elevated temperature above 1,000 °C within 2 hours. (*Yamashita's* Abstract)

The Examiner indicates that *Yamashita* teaches an alpha-alumina content in the support of less than 20% and further provides a range of lanthanoide beta-alumina content from 15% to 95%. The Examiner further indicates that *Yamashita* teaches a catalyst comprising palladium and rhodium, in which the rhodium content is 0.4 wt%.

**Kato (U.S. Patent No. 4,793,797)**

*Kato* relates to a method of catalytic combustion using a heat-resistant catalyst and, in particular, relates to a method of catalytic combustion using a heat-resistant catalyst suitable for combustion at a temperature ranging from 800 °C to 1500 °C. (*Kato's* Abstract)

The Examiner indicates that *Kato* teaches the combination of samarium and lanthanum in a rare earth hexaaluminate structure.

**C- No *prima facie* case of obviousness for the catalyst support of Group I and as recited in Group II**

Claims 1-9, 11, 13, 16-25 and 76-77 (Group I) cover a high-temperature stable catalyst support and stand rejected under 35 U.S.C. §103(a) over *McCarty* in view of *Deckman* and *Yamashita*.

Claims 40, 42-49, 80, 81 and 83-90 (Group II) cover a partial oxidation catalyst and stand rejected under 35 U.S.C. §103(a) over *McCarty* in view of *Deckman* and *Yamashita*, which are the same references used to reject the claims of Group I.

To support the rejections of claims in Group I and II, the Examiner has stated (*Final Office Action* pg. 5, lines 4-11) that *McCarty* discloses a support, the combination of alumina and hexaaluminate in the support, the use of alpha-alumina in a diffusion layer; and the individual use of hexaaluminate and perovskite in the support. The Examiner has acknowledged (*Final Office Action*, pg. 5, lines 18-20) that *McCarty* only discloses a perovskite support and a hexaaluminate support *individually*, and that *McCarty* fails to disclose the combination of these two materials in a common support. In order to remedy for the failure of *McCarty* concerning the combination of a rare earth aluminate perovskite and a rare earth hexaaluminate material in a common support, the Examiner has used *Deckman* to provide this combination in a catalyst support (*Final Office Action*, pg. 5, lines 20-21). The Examiner has pointed to *Deckman* col. 6, lines 24-37 in which *Deckman* is said to teach that “it is known for supports to be combinations of perovskites, hexaaluminates and stabilized alumina” (*Final Office Action*, pg. 5, lines 15-17).

*No teaching of the catalyst support as recited in Groups I and II*

Appellants disagree with the basis of the Examiner’s rejections. Appellants respectfully assert that the rejections set forth by the Examiner are flawed because the references do not teach all of the limitations of the support composition of Group I and as recited in Group II. Contrary to that which might be suggested in the *Final Office Action*, Appellants are not attacking the references individually and picking and choosing elements that are missing from one reference when the subject matter is taught by another cited reference. Rather, Appellants argue that some of the teachings of *McCarty* and *Deckman* have been substantially and prejudicially misinterpreted by the Examiner, and that the overall teaching of the cited art including their teaching away has been overlooked or ignored.

*McCarty*

Addressing first the teachings of *McCarty*, it was written in the *Final Office Action* (pg. 5, lines 4-8) that *McCarty* (col. 3, lines 25-31) teaches a support comprises lanthanum oxide hexaaluminate and lanthanum oxide alumina hexaaluminate (thus meeting the limitation wherein hexaaluminate and alpha-alumina or theta-alumina comprises the support). The passage from *McCarty* (col. 3, lines 25-31) quoted by the Examiner is reproduced below (the typography being consistent with the abstract of *McCarty*):

“...The first zone combustion catalyst comprises palladium oxide dispersed on a support selected from the group consisting of  $\text{La}_2\text{O}_3$ -stabilized  $\gamma\text{-Al}_2\text{O}_3$ , La-stabilized  $\gamma\text{-Al}_2\text{O}_3$ , Ce-stabilized  $\gamma\text{-Al}_2\text{O}_3$ , Ba-stabilized  $\gamma\text{-Al}_2\text{O}_3$ , and  $\text{La}_2\text{O}_3\text{-}11\text{Al}_2\text{O}_3$  hexaaluminate. The second zone combustion catalyst is selected from the group consisting of  $\text{La}_{0.5}\text{Sr}_{0.5}\text{MnAl}_{11}\text{O}_{19}$ , PdO on  $\text{La}_2\text{O}_3\text{-}11\text{Al}_2\text{O}_3$  hexaaluminate, and  $\text{La}_{0.2}\text{Sr}_{0.8}\text{MnAl}_{11}\text{O}_{19}$  with Pt.” [*McCarty* col. 3, lines 25-31]

Contrary to the Examiner's interpretation, an artisan reading this passage would not read from *McCarty* that the support may be selected from a *combination* of the distinct crystalline phases of hexaaluminate and alpha-alumina and/or theta-alumina. Rather, this means, and the artisan would understand, that the support may be selected from a stabilized gamma-alumina, or a lanthanum hexaaluminate, or a substituted lanthanum aluminate composite (e.g.,  $\text{La}_{0.2}\text{Sr}_{0.8}\text{MnAl}_{11}\text{O}_{19}$ ), each as an individual support. Furthermore, the ' $\text{La}_2\text{O}_3\text{-}11\text{Al}_2\text{O}_3$  hexaaluminate' in *McCarty* does not teach the *combination* of the two distinct hexaaluminate and alumina crystalline phases, but instead, the ' $\text{La}_2\text{O}_3\text{-}11\text{Al}_2\text{O}_3$ ' formula merely discloses the chemical composition of the lanthanum hexaaluminate. Thus, *McCarty* solely teaches individual use of stabilized  $\gamma$ -alumina, lanthanum hexaaluminate or some substituted lanthanum aluminate composites as *the* support, but fails to teach the presence of alpha-alumina and/or theta-alumina in combination with a lanthanum hexaaluminate in a common support.

Although *McCarty* describes alpha-alumina in the catalyst composition, it is NOT in the support. *McCarty* only discloses the presence of alpha-alumina in the catalyst structure as a diffusion barrier layer *applied over* a catalytic metal (see in *McCarty* Table 1 on col. 5, line 29; col. 7, lines 66-67), but not to support (i.e., carry) the catalytic metal. *McCarty* teaches *coating* the catalytic layer with this diffusion barrier layer (for example, a layer of alpha-alumina) in the catalyst, in order to generate a mass transfer resistance on top of the catalytic layer and to prevent overheating of the catalyst structure during a combustion reaction. *McCarty* does not teach nor envision the use of this alpha-alumina material as a component of the catalyst support to *carry or support* the catalytic layer.

Moreover, contrary to what the Examiner stated in the *Final Office Action*, at pg. 5, lines 10-11, alpha-alumina does not have a 'perovskite' structure. A perovskite material has a different crystalline signature than alpha-alumina for example as determined by X-Ray Diffraction. A perovskite material generally comprises at least two elements in addition to oxygen atoms, such as comprising Al and La; or Sr and Zr. See for example in *McCarty* Table 1 that  $\text{LaAlO}_3$  and  $\text{SrZrO}_3$  are listed as perovskite materials, and further in *Deckman* which discloses a general perovskite formula:  $\text{M1M2O}_{3-\alpha}$ , where M1 and M2 are each an element or mixture of elements, for example including Fe, Ni, Co, Cr, Ag, Sr, Ba, Ti, Ce, La, Mn, Zr (*Deckman* col. 6, lines 30-33).

As such, it should be recognized that the Examiner has attempted to use the language in a way that is inconsistent with the plain meaning of the words to stretch *McCarty* to read on Appellants' invention which is different. Appellants submit that *McCarty* fails to teach the presence of alpha-alumina in his catalyst support in combination with a rare earth hexaaluminate. Without alpha-alumina in the catalyst support, the Appellant's invention as set forth in the claims under appeal is different than what can be fairly suggested by *McCarty*.

Thus, contrary to what is stated in the *Final Office Action*, *McCarty* does not teach the use of alpha-alumina in the catalyst support. Furthermore, this error is NOT addressed by any other reference or anywhere further in the *Final Office Action*.

*Deckman*

Referring now to the teachings of *Deckman*, it is said by the Examiner that *Deckman* teaches the combination of a hexaaluminate and a perovskite in a catalyst support. However, *Deckman* does not describe a combination of these materials in a support.

Appellants believe that one of the threshold issues in this appeal is *whether Deckman reasonably conveys to the artisan the teaching of a high-temperature stable catalyst support comprising the combination of alumina (in an alpha form, a theta form, or both), a rare earth hexaaluminate and a rare earth aluminate perovskite.*

The passage from *Deckman* (col. 6, lines 24-37) identified by the Examiner (*Final Office Action*, pg. 5 lines 15-17) is reproduced below.

“... More preferred support materials include  $\text{Al}_2\text{O}_3$ ,  $\text{TiO}_2$ , and  $\text{ZrO}_2$ , especially as stabilized, for example with rare-earth oxides. Also more preferred are hexaaluminate supports including  $\text{LaAl}_{11}\text{O}_{18}$ , (more generally  $\text{MAl}_{11}\text{O}_{19-\alpha}$ , where M is an element or mixture of elements, for example including La, Ba, Mn, Al or, Sr). Also more preferred are perovskite supports such as  $\text{LaCrO}_3$  (more generally  $\text{M1M2O}_{3-\alpha}$ , where M1 and M2 are each an element or mixture of elements, for example including Fe, Ni, Co, Cr, Ag, Sr, Ba, Ti, Ce, La, Mn, Zr). Substituted hexaaluminate, perovskite, or mixed metal oxide supports may, in themselves, provide adequate catalytic activity for high temperature oxidation of hydrogen. Alternatively, a catalytic agent may be dispersed onto the support.” [***Deckman***. col. 6 lines 24-37]

Clearly *Deckman* is describing separate supports and NOT supports having a combination of the specific materials therein. As a teaching reference, the point upon which the Examiner is relying upon should be clearly disclosed. An artisan reading this passage from *Deckman* would NOT be taught that the support material in *Deckman* may comprise the combination of alumina, a rare earth

hexaaluminate and a rare earth aluminate perovskite. There is further no suggestion from *Deckman* on *combining* these materials in a common support for making the hydrogen combustion catalyst.

This mistaken characterization of this reference can only be interpreted as the Examiner stretching the plain meaning of the words in the reference to prevent Appellants from being awarded a patent on their claimed invention.

Focusing on the phrase “[s]ubstituted hexaaluminate, perovskite, or mixed metal oxide supports” in *Deckman* col. 6, lines 34-35, and specifically focusing on the words “or mixed metal oxide supports”, this is not a teaching of the mixture of substituted hexaaluminate and perovskite. This phrase merely lists alternate forms of ‘mixed-metal oxide’ materials, these alternate forms being other than the mixed metal oxide composites that are represented by substituted hexaaluminates and perovskites. Indeed, *Deckman* uses the “mixed-metal oxide support” language earlier in a sentence (in *Deckman* col. 6, lines 18-20) located just above this above passage in which a substituted perovskite or a substituted hexaaluminate are examples of single *mixed-metal oxide formulations*.

While some may believe this argument to be an argument in subtleties, the Examiner initiated a telephone interview on February 22, 2007, during which the Examiner pointed to another passage in *Deckman* (in col. 3, lines 50-53) as a basis for further asserting that *Deckman* discloses the combination of alumina, hexaaluminates and perovskites in a membrane material. This additional passage in *Deckman* at col. 3, lines 50-53 is reproduced below.

“...Suitable membrane materials are ceramics such as alumina and zirconia silicon carbide, silicon nitride, or combinations thereof, including for example,  $\text{Al}_2\text{O}_3$ ,  $\text{ZrO}_2$ ,  $\text{MgO}$ ,  $\text{TiO}_2$ ,  $\text{La}_2\text{O}_3$ ,  $\text{SiO}_2$ , perovskites, hexaaluminates, and metals such as nickel and high nickel content alloys, and cermets.” [*Deckman*, col. 3, lines 50-53]

The Examiner indicated that *Deckman* could be interpreted as stating that “[s]uitable membrane materials are ceramics, such as alumina, ... or combinations thereof, including for



example, ... perovskites, hexaaluminates, ..." and that this interpretation of *Deckman*'s passage was sufficient to teach a combination of alumina, perovskites and hexaaluminates in a support.

Contrary to the Examiner's assertion, this disclosure in *Deckman* does NOT reasonably convey to the artisan the combination of these three materials in a support. Arguably, the brevity of this short paragraph and the odd positioning of the expression 'or combinations thereof' which is so frequently used in patent drafting create some ambiguity in what *Deckman* meant by such 'combinations thereof'. Generally, the expression 'or combinations thereof' refer to a list of elements which precedes it, not follows it. Appellants believe that for a more appropriate interpretation of this passage, the expression 'or combinations thereof' refers to the preceding list: ceramics (such as alumina and zirconia), silicon carbide, silicon nitride. The additional coma after 'zirconia' is inserted and the reading is shown as follows: "suitable membrane materials are ceramics *such as alumina and zirconia, silicon carbide, silicon nitride, or combinations thereof, ...*". Thus, *Deckman* teaches the *combinations of ceramics, silicon carbide, and/or silicon nitride*, in which ceramics include alumina and zirconia.

Furthermore, Appellants point to another related passage in *Deckman* (in col. 4, lines 33-38) which corroborates Appellants' interpretation of the lack of teaching of the combination of these materials in a common support in *Deckman*'s passage in col. 3, lines 50-53. This passage in col. 4, lines 33-38 is located soon after *Deckman* col. 3, lines 50-53 and describes the composition of a layered asymmetric membrane illustrated by *Deckman*'s FIG. 1. In FIG. 1, the membrane (4) is comprised of catalyst (41,48), porous support (42), and permselective layers (43), stacked over each other, and the catalysts (41,48) may comprise two or more catalysts, one serving to catalyze a steam reforming reaction, the second to catalyze a water gas shift reaction.

*Deckman* discloses the respective compositions for the porous support (42) and permselective layers (43) of the membrane, as follows:

“[m]aterials that can be used for supports include alumina, zirconia, silicon carbide, and porous metals such as porous steel, nickel and alloys such as Hasteloy.” (*Deckman* col. 4, lines 27-30),

“[t]he thin selective diffusion layer may comprise a thin film of metal such as nickel, or ferrous alloys or inorganic materials such as alumina, zirconia, yttrium stabilized zirconia, silicon carbide, silicon nitride, perovskites and hexaaluminates ranging in thickness from about 100 angstroms to 500 microns.” (*Deckman* col. 4, lines 43-48).

In this disclosure, *Deckman* does not teach the combination of alumina, perovskites and hexaaluminates in a common support. Rather, *Deckman* divided the materials that are listed in col. 3, lines 50-53 into two subsets of materials of different functions: a first subset which lists suitable materials for a support (col. 4, lines 27-30), and a second subset which lists suitable materials for hydrogen selective permeation (col. 4, lines 43-48). It should be further noted that *Deckman* does not disclose the perovskites and hexaaaluminates or combinations thereof as suitable materials for *supporting* the catalytic layer (41, 48).

Moreover, the support (42) in *Deckman* is sandwiched between a catalytic layer (41, 48) and the thin selective diffusion layer (43). As a result, the thin selective diffusion layer (43) which may be a thin film of perovskites or a thin film of hexaaaluminates or a thin film of alumina does NOT support the catalytic layer (41, 48).

Furthermore, although *Deckman* generically discloses the use of alumina as a support, *Deckman* does not specifically point to the alpha or theta alumina phases as components of the support.

Appellants believe that the clarification concerning the composition of the membrane from *Deckman* and the function of each element confirms Appellants' interpretation that a support

comprising a combination of alpha-alumina and/or theta-alumina, a perovskite and a hexaaluminate is not taught nor envisioned by *Deckman*.

Based on the analysis of *Deckman* as a whole, contrary to what is stated in the *Final Office Action*, *Deckman* does not provide to the artisan a clear and unambiguous teaching of a catalyst support comprising a combination of alumina, a rare earth hexaaluminate and a rare earth aluminate perovskite. Appellants further submit that *Deckman* does not offer any guidance on the selection of the combination of alpha-alumina and/or theta-alumina, a rare earth hexaaluminate and a rare earth perovskite from the generic list of materials provided in *Deckman* col. 3, lines 50-53.

As such, *Deckman* cannot be relied upon to remedy the deficiency of *McCarty* to modify *McCarty*'s catalyst support to arrive to the present support as recited in claims of Groups I and II.

In addition, with respect to Claim 8 (of Group I) dependent from Claim 1, *McCarty* does not teach nor suggest that the rare earth hexaaluminate and the alumina phase can be intimately mixed in the support. Neither does *Deckman*.

In addition, with respect to Claim 16 (of Group I) dependent from Claim 1, *McCarty* does not teach nor suggest that the support may further comprise a rare earth oxide. Neither does *Deckman*.

While Appellants have explained in great detail on how the Examiner erred in the interpretation of the teachings of *McCarty*, *Deckman* and the combination of *McCarty* with *Deckman*, it seems unlikely that the artisan would dissect such references with the minutiae of interpretation on which the Examiner's rejections are based.

The Board should carefully consider whether a person having ordinary skill would sort through these subtle statements and come to the conclusion that, indeed, the three components in a

common catalyst support as recited in the claimed invention are present in the prior art references and then, whether a person having ordinary skill would be motivated to combine these references in the manner suggested by the Examiner to achieve the claimed invention. In essence, *the question is whether, in view of the roadmap laid-out by McCarty in Table 1 to arrive to a successful combustion catalyst, the two nebulous sentences in Deckman are really sufficient to clearly and convincingly provide the objective evidence that Appellants' catalyst support was indeed already present or suggested by the prior art.* Appellants think clearly not.

It is more believable that the Examiner used the blueprint given by Appellants' claims to find each and every element of the present claims in three or four references, and that instead of looking at the overall teachings of these references, the Examiner used these references for what he believed they should teach, rather than for what they actually do teach.

#### *Yamashita*

The Examiner has used *Yamashita* as a secondary reference to remedy to the failure of *McCarty* to teach the claimed weight percentage of the rare earth aluminate with the high aluminum to rare earth ratio (*Final Office Action*, pg. 7, lines 14-15) and failure to teach the claimed alpha-alumina content of less than 20% (*Final Office Action*, pg. 6, lines 1-4). The Examiner pointed to *Yamashita* col. 5, lines 6-12 and col. 7, lines 15-20. However, *Yamashita* was not relied upon to teach the combination of the three materials in a catalyst support, as recited in independent Claims 1, 40 and 86, and thus all of their respective dependent claims.

Since *Yamashita* does not provide nor suggest a catalyst support comprising the combination of alpha- and/or theta-alumina, a rare earth hexaaluminate and a rare earth aluminate perovskite, *Yamashita* cannot be relied upon to remedy the deficiency of the combination of *McCarty* with *Deckman*.

For these foregoing reasons, the combination of *McCarty* with *Deckman* and *Yamashita* does not provide a *prima facie* case of obviousness as required by MPEP 2143, since the combination fails to teach or suggest as a whole the catalyst support as recited in independent Claims 1, 40 and 86 and *a fortiori* in their respective dependent claims (which are rejected on the same basis).

Appellants believe that, in lieu of considering the claimed invention as a whole, the examination was carried out by the dissection of the Appellants' claims, especially the support compositions recited in Claims 1, 40 and 86, into discrete elements and by the analysis of each element in isolation. See, e.g., *W.L. Gore & Assoc., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1548, 220 USPQ 303, 309 (Fed. Cir. 1983); *Jones v. Hardy*, 727 F.2d 1524, 1530, 220 USPQ 1021, 1026 (Fed. Cir. 1983).

Ultimately, what has to be recognized is that Appellants are entitled to a patent unless a *prima facie* case of patentability is clearly and objectively presented in the *Final Office Action*. The foregoing points regarding the teaching of *Deckman*, or more precisely the lack thereof, and the teaching away from *McCarty*'s modification found in *McCarty*'s own disclosure clearly do not support a *prima facie* case of obviousness.

*Lack of motivation in the modification of McCarty's support*

For the motivation of the combination of *McCarty* with *Deckman* to arrive to the combination of a rare earth hexaaluminate and a rare earth perovskite in a catalyst support of *McCarty*, the Examiner made the following remark (*Final Office Action* pg. 5 lines 18-21) that "... it would have been obvious to one of ordinary skill in the art to provide a support comprising a hexaaluminate and a perovskite structure in *McCarty* because *McCarty* teaches these supports individually and it is

*known in the art to combine hexaaluminates and perovskites in supports (col. 6, lines 24-37) as taught by Deckman”.*

Appellants respectfully disagree with the Examiner’s suggestion that there is sufficient motivation for an artisan to modify *McCarty*’s support by using a combination of (alpha- and/or theta-) alumina, a rare earth perovskite and a rare earth hexaaluminate in the support (instead of using each as a single material in the support).

Indeed, to establish a *prima facie* case of obviousness, there must be some reason, suggestion or motivation found in the prior art where a person having ordinary skill in the field of the invention would make the required substitutions or modifications from the references themselves.

Moreover, Appellants submit that the Examiner did not establish a *reasonable* explanation in making this modification of *McCarty*’s support and further failed to provide *factual support* in the references themselves for his assertion.

With respect to the teachings about the catalyst support, Appellants believe that there is no suggestion from the references themselves on how to choose the proper combinations of materials listed as individual support materials by *McCarty* and *Deckman* for achieving a successful formulation of a combustion catalyst support while achieving the longevity that *McCarty* seeks.

To the contrary, *McCarty* expresses the non-trivial nature of formulating combustion catalysts and teaches away from changing formulation without risking many failed attempts. For example, *McCarty* goes to great length explaining the difficulties encountered in developing a commercially-viable catalytic combustion system and further explaining the underlying reasons for failures of previous attempts (see *McCarty* col. 1, lines 15-28). *McCarty* discloses that the successful combustion catalysts require extraordinary methods (see col. 4 lines 43-45) and further denigrates previous combustion catalysts (see col. 2 lines 63-65) as not being suitable for commercial success.

Thus, there is a clear signal from *McCarty* to the artisan that improvement in catalysts, especially in natural gas combustion catalysts, is not a trivial task. To alleviate the difficulty in obtaining *successful* combustion catalysts, *McCarty* offers assistance to the artisan by providing a roadmap of desired materials to be used for the support (among other catalyst components) in Table 1 and by further providing the reason for each material's use in order to achieve a desired property for the corresponding support.

Thus, to the artisan reading *McCarty*, the task of building a *successful* combustion catalyst certainly would not be done by merely picking and combining materials in a random fashion, but would be done by selecting a single material for the support of the catalyst in a deliberate fashion based on a desired property of the support. Nowhere is there in *McCarty* a suggestion or a recommendation on using a mixture of the single materials listed for the catalyst support in Table 1. *McCarty* in Table 2 only shows single materials suitable as individual support.

There is further no guidance in *McCarty* on what the impact would be on the desired property for the catalyst support if an artisan were to mix two or more of the materials (that are listed as support in Table 1) to form a catalyst support.

Moreover, *McCarty's* invention involves the construction of multi-layered catalyst overlayers that are mechanically, thermally and chemically compatible with the substrate, and that can be fabricated with commercially available materials and methods (see *McCarty* Col. 4, lines 47-51). *McCarty* thus does not envision nor suggest a mixture of materials in a single overlayer sandwiched between the catalytic layer and the substrate. That is to say, *McCarty* does not envision nor suggest a multi-component support layer; but rather *McCarty* keeps the commercially available materials separated in overlayers.

Additionally, there is no suggestion from *McCarty* to use alpha-alumina in the support, as the addition of alpha-alumina to the support of *McCarty*'s catalyst is not consistent with *McCarty*'s teaching of what the support should provide, i.e., dispersion of the catalytic ingredient. Indeed, *McCarty* is looking at a material support which disperses the catalytic metal. See for example in *McCarty* (col. 7, lines 44-47 and col. 3, lines 25-26): "...[t]he first zone combustion catalyst comprises palladium oxide *dispersed on* a support". *McCarty* is not looking at alpha-alumina in the catalyst composition to help the dispersion of the catalytic layer, that is to say, to help increase the reaction rate, but *rather* intends to use alpha-alumina in a diffusion barrier layer to help decrease the reaction rate by placing a restriction on the convective diffusion rate of natural gas (*McCarty* col. 2, lines 37-41), in order to moderate the catalyst wall temperature below the very high adiabatic temperature to prevent overheating of the catalyst (*McCarty* col. 10, lines 27-38).

Accordingly, the function and the location of the alpha-alumina in *McCarty*'s catalyst composition differs from that of the alpha-alumina in the catalyst support as recited in Appellants' Claims 1, 40 and 86 and all of their respective dependent claims. As such, Appellants submit that the Examiner did not provide a sufficient reason on why an artisan would modify *McCarty*'s support by adding alpha-alumina, theta-alumina or both as a component of the catalyst support.

Additionally, Appellants further submit that there is no motivation for an artisan to add alpha-alumina into the support composition of *McCarty*. In fact, *Yamashita* provides some corroborating evidence that there would be no reason for an artisan to include alpha-alumina in *McCarty*'s support. In FIG. 5, curve 21 and col. 11, lines 15 & 51-52, *Yamashita* discloses the poor performance of a Pd catalyst supported on alpha-alumina and its failure to ignite the reactant mixture in a methane combustion test. This poor performance of *Yamashita*'s catalyst in the same process that *McCarty* is aiming at improving (*McCarty* col. 3, lines 1-2; col. 3, lines 49-52; col. 4, lines 43-46) is a definite teaching away from the presence of alpha-alumina in a combustion catalyst support.



Assuming, *arguendo*, that an artisan were to find in *Deckman* (although Appellants believe he/she would not) the combination of alpha-alumina and/or theta-alumina, a rare earth aluminate of perovskite structure and a rare earth hexaaluminate in a support from the generic list of suitable support materials provided by *Deckman*, Appellants fail to see how the artisan would be compelled to modify *McCarty*'s catalyst support with this combination of materials, when *McCarty* clearly states to tread carefully in formulating a combustion catalyst for risk of not achieving success in preventing catalyst degradation during its use at high-temperature conditions, and for risk in obtaining an unsuccessful catalyst combustion (like the previous natural gas combustion catalysts that were denigrated by *McCarty*).

There is further no motivation from the prior art itself in modifying *McCarty*'s support by adding theta-alumina and/or alpha-alumina (even in an amount of less than 20%) to the catalyst support.

Appellants argue that the mere possibility that these three materials could be combined in the support to lead to the specific high temperature stable composition support recited in Claims 1, 40 and 86 does not render the catalyst support of Claim 1 and the catalysts of Claims 40 and 86 obvious, when the prior art does not suggest the desirability of such modification or combination. Since the combination of these materials will clearly deviate from *McCarty*'s roadmap, it is unlikely that the artisan will disregard *McCarty*'s teachings without risking numerous unsuccessful attempts. Again, the Examiner seemed to have been misguided by hindsight reconstruction by reading into the references what he wanted to find, rather than what the artisan would have reasonably found and be guided to do when reading these references.

One of the pivotal questions for the Board to consider for motivation is whether, after reading these references, the artisan armed with his/her ordinary skill and creativity would unhesitantly

construct a variation of *McCarty*'s support and catalyst as presented in the claimed invention with a reasonable expectation of success? Appellants think clearly not, especially when *McCarty* cautions the artisan of the non-trivial task in creating successful combustion catalysts. *McCarty* has precisely laid out catalyst compositions which *McCarty* forecasts to be successful in combustion reactions, but these successful catalyst compositions from *McCarty* do not include the combinations of the three materials in the catalyst support as recited in the Appellants' claims.

Appellants do not believe it is so. Appellants believe that, if an artisan were attempting this variation, he/she could not confidently predict yielding a successful thermally stable composition effective for use in a high-temperature reaction. Such combination of materials would be with complete disregard of the roadmap carefully laid-out by *McCarty*. As such, Appellants argue that there is no motivation nor suggestion from the references themselves in modifying *McCarty*'s catalyst support to combine some of the support materials disclosed by these references, And there is further no guidance to the artisan on how to choose the proper combination of materials disclosed by these references in order to achieve successful support and supported catalyst formulations with a desired longevity that *McCarty* expects under high-temperature conditions.

For all of the reasons stated above, the combination of these references fails to support a motivation to combine with a reasonable expectation of success, as required by **MPEP 2143.01 and 2143.02**. Appellants believe that the failure of the prior art to suggest the modification of the support composition to arrive to the support composition of claims of Group I and to the support composition recited in claims of Group II render these claims patentable.

Appellants respectfully request the reversal of the 35.U.S.C. §103(a) rejection on these claims for lack of *prima facie*.

**D- No *prima facie* case of obviousness for the catalyst of Group II**

As already stated above with respect to the catalyst support composition recited in claims of Group II, and particularly in independent Claims 40 and 86, Appellants have argued that the combination of *McCarty* with *Deckman* and *Yamashita* does not provide nor suggest the support composition comprising the three materials recited in these claims, and that the Examiner erred in rejecting the claims of Group II on that basis.

Appellants further argued that there is no motivation from the references themselves in modifying *McCarty*'s support without a suggestion on how to choose the proper combination of support materials disclosed by these references in order to achieve a successful catalyst formulation with a desired longevity that *McCarty* expects under high-temperature conditions. There is further no motivation from the references themselves in modifying *McCarty*'s support by adding alpha-alumina to the catalyst support. To the contrary, *Yamashita* teaches away from the use of alpha-alumina as a support material in *McCarty*'s combustion process.

The Examiner has further used the combination of *McCarty* with *Yamashita* to reject the catalyst claims of Group II. *Yamashita* is said to teach the claimed content range of rhodium in the catalyst composition as recited in claims of Group II, which *McCarty* fails to teach (*Final Office Action*, pg. 8, lines 19-21). The Examiner pointed to *Yamashita* col. 13, lines 27-33 where *Yamashita* discloses a catalyst comprising 1.5 wt% platinum and 0.4 wt% rhodium. For the motivation to modify *McCarty*'s catalyst with *Yamashita*'s teachings to arrive to the rhodium content in *McCarty*'s catalyst, the Examiner further stated (*Final Office Action*, pg. 9, lines 1-6) that "it would have been obvious to one of ordinary skill in the art to provide a catalyst comprising 1.5 wt% of platinum and 0.4 wt% of rhodium, because it is well known to do so in a substantially similar temperature support

as taught by Yamashita. The prior art range (0.4 wt% of rhodium) is so close (claimed range 0.5-10 wt% of rhodium) that one skilled in the art would have expected it to have the same properties. *Titanium Metals Corp. v. Banner*, 227 USPQ 773.”

Appellants respectfully disagree with the Examiner’s statement viv-a-vis the suggested modification of *McCarty*’s catalyst.

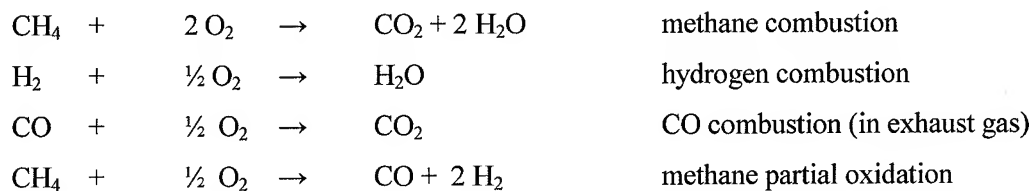
With respect to the teaching of the active ingredient loadings recited in Appellants’ Claims 40, 85, 86 and 89, the combination of *McCarty* with *Yamashita* does not provide nor suggest the modification of the active ingredient and the rhodium loading as suggested by the Examiner to arrive to the present partial oxidation catalyst of Group II and particularly of Claims 40, 85, 86 and 89.

Specifically for Claim 40 and its dependent claims, *McCarty* fails to disclose iridium or ruthenium in the active ingredient of the combustion catalyst, and neither of the secondary references (*Yamashita* and *Deckman*) highlights these metals as a reasonable substitution to arrive at a successful partial oxidation catalyst.

Additionally, for Claims 40, 85, 86 and 89, the artisan would have to remove palladium from the catalyst composition disclosed by *Yamashita* to arrive to the claimed catalyst of these claims, since Pd is not required in these claims. However, there is no teaching, nor suggestion from *Yamashita* to remove palladium from the catalyst composition. Instead, rhodium is used in conjunction with palladium.

Appellants further respectfully disagree with the use of teachings related to combustion catalysts to reject claims concerning *partial oxidation* catalysts. Indeed, none of the three references (*McCarty*, *Deckman*, *Yamashita*) disclose catalysts suitable for a partial oxidation reaction as recited in claims of Group II. *McCarty* discloses a combustion catalyst, specifically for natural gas

combustion (*McCarty* Abstract; Table 2). *Deckman* describes catalyst compositions for hydrogen combustion and steam reforming reaction (*Deckman* Abstract; col. 2, line 64 to col. 3, line 18; col. 6, lines 11-45). *Yamashita* describes catalyst compositions for combustion reactions of fuels (such as hydrogen, carbon monoxide, hydrocarbons or alcohols), deodorization, denitration reaction, high-temperature steam reforming reaction and cleaning of automobile exhaust gas. (*Yamashita* col. 7, line 59 to col. 9, line 7), the catalyst for cleaning of automobile exhaust gas being said to be relevant with regard to the active ingredient composition of the present claimed invention of Group II. Please see some of the various catalytic reactions below.



In the instant matter, because of the known differences to the artisan between these chemical reactions, specifically between catalytic combustion (full-stoichiometric oxidative conversion of hydrocarbon(s) with  $\text{O}_2$  to  $\text{H}_2\text{O}$  and  $\text{CO}_2$ ), cleaning of automobile exhaust gas (oxidative conversion of CO and hydrocarbon(s) with  $\text{O}_2$  to  $\text{H}_2\text{O}$  and  $\text{CO}_2$ ) and catalytic partial oxidation (sub-stoichiometric selective oxidative conversion of hydrocarbon(s) with  $\text{O}_2$  to  $\text{H}_2$  and CO) and the general unpredictability in the chemical arts, an artisan at the time of Appellants' invention would not have been motivated to modify or substitute the active ingredient in *McCarty*'s combustion catalyst composition with the active ingredient of a catalyst for cleaning of automobile exhaust gas in *Yamashita*'s patent, when seeking to develop a catalytic partial oxidation catalyst for the production of synthesis gas.

Indeed, it cannot be presumed that the active ingredient of a catalyst for cleaning of automobile exhaust gas such as disclosed by *Yamashita* is a reasonable substitution for a suitable active ingredient

in *McCarty* to arrive to an effective catalytic partial oxidation catalyst due to the general unpredictability in the chemical arts. In fact, there is no reasonable guidance in the references themselves to apply their combined teachings to a partial oxidation catalyst composition, and there is no reasonable expectation in these references that the modified catalyst as suggested by the Examiner would be successful as a partial oxidation catalyst with suitable activity, selectivity and stability. Particularly, there is no expectation that combustion catalysts in *McCarty* and *Yamashita* would be selective towards the formation of CO and H<sub>2</sub>, when they are clearly designed to be selective towards the formation of CO<sub>2</sub> and/or H<sub>2</sub>O.

At best, one of skill in the art might be led to try to modify the combustion catalyst composition of *McCarty* as suggested by the Examiner (that is to say, use a combination of Pd and Rh as catalytic metals) and then find out whether the Pd/Rh combination is suitable as a combustion catalyst with the modified *McCarty*'s support, but not whether the Pd/Rh combination is suitable as a catalytic partial oxidation catalyst. There is no hint from *McCarty* and *Yamashita* that this combination of Rh/Pd or even Rh alone could provide a catalyst selective for the production of CO and H<sub>2</sub> (rather than a catalyst selective for the production of the combustion reaction products H<sub>2</sub>O and/or CO<sub>2</sub>).

For at least these reasons, the rhodium loading in *Yamashita* is not combinable with *McCarty* and does not render obvious Appellants' claims of Group II, and particularly Claims 40, 85, 86, and 88.

With respect to the teaching of the rhodium surface area recited in catalyst Claim 90 which depends from independent Claim 86, none of the cited references (*McCarty*, *Deckman*, *Yamashita*) teaches or suggests a minimum rhodium surface area of at least 0.5 m<sup>2</sup> rhodium per gram to arrive to this catalyst claim. Appellants thus argue that the combination of these references fails to teach this limitation.

For all of the foregoing reasons stated above in this section D and the previous section C, Appellants believe that the claims of Group II are patentable over the cited references, and Appellants respectfully request the reversal of the 35.U.S.C. §103(a) rejection on these claims for lack of *prima facie*.

**E- No *prima facie* case of obviousness for the catalyst support of Group III**

The claimed invention of Group III represented by Claim 12 covers a high-temperature stable catalyst support and is finally rejected under 35 U.S.C. §103(a) over *McCarty* in view of *Deckman*, *Yamashita* and *Kato*. *McCarty*, *Deckman* and *Yamashita* are the same references used to reject the claims of Group I represented by independent Claim 1 from which Claim 12 depends.

*McCarty* discloses the use of lanthanum hexaaluminate as an individual support, but fails to disclose the combination of lanthanum (La) and samarium (Sm) in the hexaaluminate material for use as a component of the catalyst support of Claim 12. To reject Claim 12, the Examiner has used *Kato* to provide the combination of La and Sm in the hexaaluminate material.

*Kato* supplies a list of rare earth metals acceptable to use in a rare earth-beta-alumina material (see relevant passage in *Kato* in col. 16, lines 31-36). However, there is no guidance from *Kato* and *McCarty* to select this particular rare earth metal, Sm, to combine with La in the hexaaluminate structure, and without some expectation from *Kato* and *McCarty* on an increased thermal stability in the resulting catalyst support. Thus, it seems unlikely that an artisan having access to *McCarty*'s catalyst support and having read *Kato* would not be motivated to modify *McCarty*'s catalyst support to arrive to the present catalyst of Claim 12 by selecting samarium from *Kato*'s disclosed list of acceptable rare earth metals.

*Kato* further does not offer any direction as to which of the many acceptable rare earth metals to be combined with La is likely to result in a support as successful as the lanthanum hexaaluminate

of *McCarty*. To the contrary, *Kato* states that the kind of material of the carrier *per se* is not critical in the present invention. See *Kato* col. 3, lines 9-12. Moreover, the heat resistance of *Kato*'s catalyst is NOT effected by interchanging or combining the rare earth metals in the hexaaluminate structure. Rather, the heat resistance of *Kato*'s catalyst is mostly effected by adding, in the catalyst composition, an oxide of a base metal element having an ionic radius smaller than that of palladium. These specific base metal elements (including Mg, Mn, Ni, Co, Zr, Cr, Sn, Zn) seem to suppress the agglomeration of noble metal particles present in *Kato*'s catalyst. See *Kato* col. 3, lines 23-11. Additionally, *Kato* does not give any indication or hint that the combination of samarium and lanthanum in a hexaaluminate is more desirable or critical in achieving a heat-resistant catalyst.

*Kato* was not relied upon to provide the combination of alpha-alumina and/or theta-alumina, a rare earth hexaaluminate and a rare earth aluminate perovskite in the common support. As stated earlier, the combination of *McCarty* in view of *Deckman* and *Yamashita* fails to teach all of the elements of Claim 1 from which Claim 12 depends. *Kato* also fails to provide this missing limitation.

Furthermore, there is no motivation from these four references to use a combination of alpha-alumina and/or theta-alumina, a rare earth aluminate perovskite and a rare earth hexaaluminate comprising Sm and La in *McCarty*'s support. Indeed, as explained earlier, there is no motivation from *McCarty* to add alpha-alumina as a component in *McCarty*'s catalyst support, because such addition is not consistent with *McCarty*'s teaching of what the support should provide (sufficient surface area for the dispersion of catalytic metal). Additionally, the combination of these materials is not consistent with the roadmap provided by *McCarty* in designing successful combustion catalysts.

Appellants thus submit that the combination of *McCarty* with *Deckman*, *Yamashita* and *Kato* fails to provide all of the elements of the catalyst support of dependent Claim 12 as required by



**MPEP 2143.03**, and further the combination of these references fails to provide the motivation or suggestion to arrive to the high-temperature stable support of Claim 12 with a reasonable expectation of success, as required by **MPEP 2143.01 and 2143.02**.

Appellants respectfully request the Board to reverse the 103 rejection of Claim 12 for lack of *prima facie*.

#### **F- Withdrawn claims of non-elected inventions**

Claims 26-35, 37-39, 50-55, 57-58, 60-74 & 78-79 were withdrawn as non-elected inventions, as identified in the Restriction Requirement of January 25, 2006.

Claims 26-35, 37-39 and 78-79 cover a method of making a catalyst support. Withdrawn independent Claim 26 (from which 27-35, 37-39 and 78-79 depend) carries all of the limitations pertaining to the catalyst support composition of presently examined Claim 1 which Appellants believe is patentable.

Claims 50-55, 57-58 and 60-74 cover a method for making synthesis gas using a catalyst. Withdrawn independent Claim 50 (from which Claims 51-55, 57-58 and 60-74 depend) carries all of the limitations pertaining to the catalyst composition of presently examined Claim 40 which Appellants believe is patentable.

In the *Final Office Action* (pg. 3, lines 9-12), Appellants have noted the Examiner's statement on the applicability of rejoinder of these withdrawn claims based on **MPEP §821.04(b)**. Therefore Appellants will be very appreciative for the reconsideration of the rejoinder of Claims 26-35, 37-39 and 78-79 upon the reversal of the rejection on the appealed independent Claim 1, and for the reconsideration of the rejoinder of Claims 50-55, 57-58 and 60-74 upon the reversal of the rejection on the appealed independent Claim 40.

**VIII. CONCLUSION**

Appellants believe that what has been presented should be fully persuasive for allowability. Favorable action from the Board's earliest convenience is respectfully solicited. Appellants respectfully request that the final rejection on the claims of Groups I, II, and III be reversed for the allowance of these claims.

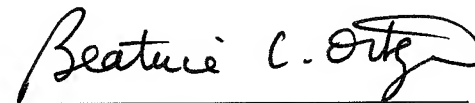
Furthermore, based on MPEP §821.04, Appellants believe that withdrawn Claims 26-35, 37-39, 50-55, 57-58, 60-74 & 78-79 should be rejoined to the examination of the present application, for they contain the allowable subject matter contained in the examined independent Claims 1 and 40 and are free from 35 U.S.C. §101 or §112, first paragraph issues.

Should there be any remaining issue which the Examiner believes would possibly be resolved by a conversation or should the Examiner would like to suggest critical language to put this application in condition for immediate allowance, the Examiner is invited to call the undersigned at (281) 293-4751 or any other practitioner of record.

Respectfully submitted,

CONOCOPHILLIPS COMPANY - IP LEGAL

Date: July 27, 2007



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## IX. CLAIMS APPENDIX

The text of the claims involved in the appeal reads as follows:

1. (Previously presented) A high temperature stable catalyst support comprising the following crystalline structures:

an alumina phase selected from the group consisting of alpha-alumina, theta-alumina and combinations thereof;

a rare earth aluminate of a hexaaluminate or hexaaluminate-like structure comprising at least one rare earth metal and having a high molar ratio of aluminum to rare earth metal between 11:1 and 14:1; and

a rare earth aluminate of a perovskite or perovskite-like structure comprising the at least one rare earth metal and having a low molar ratio of aluminum to rare-earth metal of less than 2:1,

wherein the catalyst support contains not more than 20% of alpha-alumina, and less than 100 wt% to about 1 wt% of the rare earth aluminate with the high molar ratio of aluminum to rare earth metal.

2. (Previously presented) The catalyst support of claim 1 wherein the catalyst support comprises between 5 and 50 percent by weight of the rare earth aluminate with the high molar ratio of aluminum to rare earth metal based on the total weight of the catalyst support.

3. (Previously presented) The catalyst support of claim 1 wherein the at least one rare earth metal is selected from the group consisting of lanthanum, neodymium, praseodymium, cerium, samarium, and combinations thereof.

4. (Previously presented) The catalyst support of claim 1 wherein both rare earth aluminates comprise lanthanum.

5. (Previously presented) The catalyst support of claim 1 wherein the catalyst support comprises between about 1 wt% and about 10 wt% of lanthanum as the at least one rare earth metal.

6. (Previously presented) The catalyst support of claim 1 wherein the rare earth aluminate with

the high molar ratio of aluminum to rare earth metal further comprises an element from Groups 1-14 of the Periodic Table of Elements.

7. (Previously presented) The catalyst support of claim 1 wherein the rare earth aluminate with the high molar ratio of aluminum to rare earth metal further comprises nickel, magnesium, barium, potassium, sodium, manganese, a second rare earth metal or combinations thereof.

8. (Previously presented) The catalyst support of claim 1 wherein the rare earth aluminate with the high molar ratio of aluminum to rare earth metal and the alumina phase are intimately mixed.

9. (Previously presented) The catalyst support of claim 1 wherein the rare earth aluminate with the high molar ratio of aluminum to rare earth metal coats the alumina phase partially or completely.

11. (Previously presented) The catalyst support of claim 1 wherein the rare earth aluminate with the high molar ratio of aluminum to rare earth metal has a chemical formula of  $\text{LnAl}_y\text{O}_z$ , where y is between 11 and 14; and z is between 18 and 23, Al and O represent aluminum atoms and oxygen atoms respectively; and where Ln comprises lanthanum, neodymium, praseodymium, samarium, or combinations thereof.

12. (Previously presented) The catalyst support of claim 1 wherein the rare earth aluminate with the high molar ratio of aluminum to rare-earth metal has a chemical formula of  $\text{MAI}_y\text{O}_z$ , where y is between 11 and 12; z is between 18 and 19; Al and O represent aluminum atoms and oxygen atoms respectively; and M comprises a combination of lanthanum and samarium.

13. (Previously presented) The catalyst support of claim 1 wherein the rare earth aluminate with the high molar ratio of aluminum to rare-earth metal comprises a lanthanum hexaaluminate.

16. (Previously presented) The catalyst support of claim 1 further comprising an oxide of the at least one rare earth metal.

17. (Original) The catalyst support of claim 1 wherein the catalyst support has a surface area greater than  $2 \text{ m}^2/\text{gram}$ .

18. (Original) The catalyst support of claim 1 wherein the catalyst support has a surface area

lower than 30 m<sup>2</sup>/gram.

19. (Previously presented) The catalyst support of claim 1 wherein the catalyst support comprises between 1 wt% and 10 wt% of the at least one rare earth metal.

20. (Previously presented) The catalyst support of claim 1 wherein the catalyst support is made by impregnating a solution of the at least one rare earth metal onto an aluminum-containing precursor; and calcining at a temperature between 1,000°C and 1,600°C.

21. (Original) The catalyst support of claim 20 wherein the aluminum-containing precursor comprises an aluminum structure selected from the group consisting of bayerite, gibbsite, boehmite, pseudo-boehmite, bauxite, gamma-alumina, delta-alumina, chi-alumina, rho-alumina, kappa-alumina, eta-alumina, theta-alumina, and combinations thereof.

22. (Original) The catalyst support of claim 20 wherein the aluminum-containing precursor comprises at least one transition alumina selected from the group consisting of gamma-alumina, delta-alumina, chi-alumina, rho-alumina, kappa-alumina, eta-alumina, and theta-alumina.

23. (Previously presented) The catalyst support of claim 20 wherein the aluminum-containing precursor comprises gamma-alumina.

24. (Previously presented) The catalyst support of claim 23 wherein calcining is done at a temperature between about 1,200 °C and about 1,300 °C.

25. (Original) The catalyst support of claim 23 wherein calcining is done at a temperature between 1,100°C and 1,400°C.

26. (Withdrawn) A method for making a thermally stable aluminum-based catalyst support comprising:

- (a) impregnating a solution of a rare earth metal onto an aluminum-containing precursor;
- (b) drying the impregnated aluminum-containing precursor; and
- (c) calcining at a temperature between 1,000 °C and 1,600 °C in a manner effective to convert a portion of said aluminum-containing precursor to an aluminum oxide

phase comprising alpha-alumina, theta-alumina, or combinations thereof, and to convert another portion of said aluminum-containing precursor with at least a fraction of said rare earth metal to a rare earth aluminate of a hexaaluminate or hexaaluminate-like structure with a high molar ratio of aluminum to rare earth metal between 11:1 and 14:1, and further to a second rare earth aluminate of a perovskite or perovskite-like structure with a low molar ratio of aluminum to rare earth metal of less than 2:1,

such that the catalyst support comprises said rare earth aluminate with the low molar ratio of aluminum to rare-earth metal; the aluminum oxide phase comprising less than 20 wt% of alpha-alumina; and less than 100 wt% to about 1 wt% of said rare earth aluminate with the high molar ratio of aluminum to rare earth metal.

27. (Withdrawn) The method of claim 26 wherein the aluminum-containing precursor comprises an aluminum structure selected from the group consisting of bayerite, gibbsite, boehmite, pseudo-boehmite, bauxite, gamma-alumina, delta-alumina, chi-alumina, rho-alumina, kappa-alumina, eta-alumina, theta-alumina, and combinations thereof.

28. (Withdrawn) The method of claim 26 wherein the aluminum-containing precursor comprises a transition alumina selected from the group consisting of gamma-alumina, delta-alumina, chi-alumina, rho-alumina, kappa-alumina, eta-alumina, theta-alumina, and combinations thereof.

29. (Withdrawn) The method of claim 26 wherein the aluminum-containing precursor comprises gamma-alumina.

30. (Withdrawn) The method of claim 29 wherein calcining is done at a temperature between about 1,200 °C and about 1,300 °C.

31. (Withdrawn) The method of claim 29 wherein calcining is done at a temperature between 1,100 °C and 1,400 °C.

32. (Withdrawn) The method of claim 26 wherein the rare earth metal is selected from the group consisting of lanthanum, neodymium, praseodymium, cerium and combinations thereof.

33. (Withdrawn) The method of claim 26 wherein both rare earth aluminates comprise lanthanum.
34. (Withdrawn) The method of claim 26 wherein calcining is further effective to further convert another portion of the rare earth metal solution into an oxide of said rare earth metal, said rare earth oxide consisting essentially of rare earth metal atoms and oxygen atoms.
35. (Withdrawn) The method of claim 26 wherein the solution of rare earth metal comprises more than one rare-earth metal.
37. (Withdrawn) The method of claim 26 wherein the rare earth aluminate with the high molar ratio of aluminum to rare earth metal comprises a lanthanum hexaaluminate.
38. (Withdrawn) The method of claim 26 wherein the catalyst support comprises between about 0.5 and about 10 percent by weight of the rare earth metal based on the total weight of the catalyst support.
39. (Withdrawn) The method of claim 26 wherein the catalyst support comprises between about 5 and about 50 percent by weight of the rare earth aluminate with the high molar ratio of aluminum to rare earth metal based on the total weight of the catalyst support.
40. (Previously presented) A partial oxidation catalyst comprising:
- (a) an active ingredient comprising a rhodium alloy or a metal selected from the group consisting of rhodium, iridium, ruthenium and combinations thereof, wherein, when the active ingredient comprises rhodium, said rhodium is in an amount of from about 0.1 wt% to about 20 wt% based on the total catalyst weight; and
  - (b) a support onto which the active ingredient is dispersed, said support comprising
    - an alumina phase selected from the group consisting of alpha-alumina, theta-alumina and combinations thereof;
    - a rare earth aluminate of a hexaaluminate or hexaaluminate-like structure comprising a rare-earth metal and having a high molar ratio of aluminum to rare earth metal between 11:1 and 14:1; and
    - a rare earth aluminate of a perovskite or perovskite-like structure comprising the

rare-earth metal and having a low molar ratio of aluminum to rare earth metal of less than 2:1;

wherein the support comprises less than 100 wt% to about 1 wt% of said rare earth aluminate with the high molar ratio of aluminum to rare earth metal based on the total weight of the support.

42. (Previously presented) The partial oxidation catalyst of claim 40 wherein the rare earth aluminate with the high molar ratio of aluminum to rare earth metal comprises a lanthanide hexaaluminate, and the lanthanide metal is selected from the group consisting of lanthanum, neodymium, praseodymium, samarium, and combinations thereof.

43. (Original) The partial oxidation catalyst of claim 42 wherein the lanthanide hexaaluminate comprises a lanthanide metal selected from the group consisting of lanthanum, neodymium, praseodymium, and combinations thereof.

44. (Original) The partial oxidation catalyst of claim 42 wherein the lanthanide hexaaluminate comprises lanthanum.

45. (Original) The partial oxidation catalyst of claim 40 wherein the rare earth metal is selected from the group consisting of lanthanum, neodymium, praseodymium, and combinations thereof.

46. (Previously presented) The partial oxidation catalyst of claim 40 wherein both rare earth aluminates comprise lanthanum.

47. (Previously presented) The partial oxidation catalyst of claim 40 wherein the rare earth aluminate with the high molar ratio of aluminum to rare earth metal comprises more than one rare-earth metal.

48. (Original) The partial oxidation catalyst of claim 40 wherein the support has a surface area greater than 2 m<sup>2</sup>/gram.

49. (Previously presented) The partial oxidation catalyst of claim 40 wherein the support comprises between about 5 and about 50 percent by weight of the rare earth aluminate with the high molar ratio of aluminum to rare-earth metal based on the total weight of the support.



50. (Withdrawn) A method for making synthesis gas comprising:  
converting a gaseous hydrocarbon stream and an oxygen-containing stream over a partial oxidation catalyst, to make a product stream comprising CO and H<sub>2</sub>,  
wherein said partial oxidation catalyst includes  
an active ingredient comprising a rhodium alloy or a metal selected from the group consisting of rhodium, iridium, ruthenium, and combinations thereof, wherein, when the active ingredient comprises rhodium, said rhodium is in an amount of from about 0.1 wt% to about 20 wt% based on the total catalyst weight; and  
a support onto which the active ingredient is dispersed, said support comprising  
an alumina phase selected from the group consisting of alpha-alumina, theta-alumina and combinations thereof;  
a rare earth aluminate of a hexaaluminate or hexaaluminate-like structure comprising a rare earth metal and having a high molar ratio of aluminum to rare earth metal between 11:1 and 14:1; and  
a rare earth aluminate of a perovskite or perovskite-like structure comprising the rare-earth metal and having a low molar ratio of aluminum to rare earth metal of less than 2:1;  
wherein the support comprises less than 100 percent to about 1 percent by weight of said rare earth aluminate with the high molar ratio of aluminum to rare earth metal based on the total weight of the support.
51. (Withdrawn) The method of claim 50 wherein the support comprises between about 1 and about 50 percent by weight of said rare earth aluminate with the high molar ratio of aluminum to rare earth metal based on the total weight of the support.
52. (Withdrawn) The method of claim 50 wherein the rare earth metal is selected from the group consisting of lanthanum, neodymium, praseodymium, cerium, and combinations thereof.
53. (Withdrawn) The method of claim 50 wherein the rare earth aluminate with the high molar ratio of aluminum to rare earth metal comprises lanthanum.
54. (Withdrawn) The method of claim 50 wherein the support comprises between about 1 and

about 10 percent by weight of lanthanum based on the total weight of catalyst support.

55. (Withdrawn) The method of claim 50 wherein the rare earth aluminate with the high molar ratio of aluminum to rare earth metal comprises lanthanum and samarium.

57. (Withdrawn) The method of claim 50 wherein the rare earth aluminate with the high molar ratio of aluminum to rare earth metal and the alumina phase are intimately mixed.

58. (Withdrawn) The method of claim 50 wherein the rare earth aluminate with the high molar ratio of aluminum to rare earth metal coats the alumina phase partially or completely.

60. (Withdrawn) The method of claim 50 wherein the rare earth aluminate with the high molar ratio of aluminum to rare earth metal comprises a lanthanum hexaaluminate.

61. (Withdrawn) The method of claim 50 wherein the support comprises between about 1 wt% and about 10 wt% of the rare earth metal.

62. (Withdrawn) The method of claim 50 wherein the conversion is done at a GHSV between about 20,000 hr<sup>-1</sup> to about 100,000,000 hr<sup>-1</sup>.

63. (Withdrawn) The method of claim 50 wherein the conversion is done at a temperature between about 350 °C to about 2,000 °C.

64. (Withdrawn) The method of claim 50 wherein the conversion is done at a pressure between about 100 kPa to about 4,000 kPa.

65. (Withdrawn) The method of claim 50 wherein the hydrocarbon stream comprises natural gas.

66. (Withdrawn) The method of claim 50 wherein the hydrocarbon stream comprises at least about 50% by volume of methane.

67. (Withdrawn) The method of claim 50 wherein the partial oxidation catalyst comprises rhodium.

68. (Withdrawn) The method of claim 67 wherein the partial oxidation catalyst comprises between about 0.5 wt% and about 10 wt% of rhodium.
69. (Withdrawn) The method of claim 67 wherein the partial oxidation catalyst has a rhodium surface area greater than about 0.5 m<sup>2</sup>/g.
70. (Withdrawn) The method of claim 67 wherein the partial oxidation catalyst further comprises samarium.
71. (Withdrawn) The method of claim 50 wherein the catalyst exhibits hydrocarbon conversion of equal to or greater than about 85%.
72. (Withdrawn) The method of claim 50 wherein the partial oxidation catalyst has a hydrogen selectivity equal to or greater than about 85%.
73. (Withdrawn) The method of claim 50 wherein the product stream comprising CO and H<sub>2</sub> has a H<sub>2</sub>:CO molar ratio between about 1:4:1 and 2.3.
74. (Withdrawn) The method of claim 50 wherein at least a portion of the product stream comprising CO and H<sub>2</sub> is further converted to hydrocarbons.
76. (Previously presented) The catalyst support of claim 1 wherein the catalyst support comprises between 1 and 50 percent by weight of the rare earth aluminate with the high molar ratio of aluminum to rare earth metal based on the total weight of the catalyst support.
77. (Previously presented) The catalyst support of claim 1 wherein the catalyst support comprises more than 40 wt% and less than 100 wt% of the rare earth aluminate with the high molar ratio of aluminum to rare earth metal based on the total weight of the catalyst support.
78. (Withdrawn) The method of claim 26 wherein the catalyst support comprises between about 1 and about 50 percent by weight of the rare earth aluminate with the high molar ratio of aluminum to rare earth metal based on the total weight of the catalyst support.
79. (Withdrawn) The method of claim 26 wherein the catalyst support comprises more than 40 wt% and less than 100 wt% of the rare earth aluminate with the high molar ratio of aluminum

to rare earth metal

80. (Previously presented) The partial oxidation catalyst of claim 40 wherein the support comprises between about 1 and about 50 percent by weight of the rare earth aluminate with the high molar ratio of aluminum to rare earth metal based on the total weight of the support.

81. (Previously presented) The partial oxidation catalyst of claim 40 wherein the support comprises more than 40 wt% and less than 100 wt% of the rare earth aluminate with the high molar ratio of aluminum to rare earth metal based on the total weight of the support.

83. (Previously presented) The catalyst support of claim 40 wherein the support comprises not more than about 20 wt% alpha-alumina.

84. (Previously presented) The catalyst of claim 40 wherein the partial oxidation catalyst comprises a rhodium alloy, said rhodium alloy comprising a metal selected from the group consisting of ruthenium, iridium, platinum, palladium, tantalum, niobium, molybdenum, rhenium, tungsten, cobalt, and zirconium.

85. (Previously presented) The catalyst of claim 40 wherein the partial oxidation catalyst comprises between about 0.5 wt% and about 10 wt% of rhodium.

86. (Previously presented) A partial oxidation catalyst comprising:

(a) an active ingredient comprising rhodium or a rhodium alloy, said rhodium alloy comprising rhodium and a metal selected from the group consisting of ruthenium, iridium, platinum, palladium, tantalum, niobium, molybdenum, rhenium, tungsten, cobalt, and zirconium, said rhodium being in an amount of from 0.1 wt% to about 20 wt% based on the total catalyst weight; and

(b) a support onto which the active ingredient is dispersed, said support comprising:  
an alpha-alumina phase;

less than 100 percent to about 1 percent by weight of a rare earth aluminate of a hexaaluminate or hexaaluminate-like structure, with a high molar ratio of aluminum to rare-earth metal between 11:1 and 14:1, and comprising at least one rare earth metal selected from the group

consisting of lanthanum, neodymium, praseodymium, samarium, and combinations thereof; and  
a rare earth aluminate of a perovskite structure comprising the at least one rare earth metal  
with a low molar ratio of aluminum to rare-earth metal of less than 2:1.

87. (Previously presented) The partial oxidation catalyst of claim 86 wherein the rare earth aluminate with the high molar ratio of aluminum to rare-earth metal comprises between 5 and 45 percent by weight of the total weight of the catalyst support.

88. (Previously presented) The partial oxidation catalyst of claim 86 wherein the rare earth aluminate with the high molar ratio of aluminum to rare-earth metal comprises more than 40 percent and less than 100 percent by weight of the total weight of the catalyst support.

89. (Previously presented) The partial oxidation catalyst of claim 86 wherein the partial oxidation catalyst comprises between about 0.5 wt% and about 10 wt% of rhodium.

90. (Previously presented) The partial oxidation catalyst of claim 86 wherein the partial oxidation catalyst comprises rhodium and has a rhodium surface area greater than about 0.5 m<sup>2</sup>/g rhodium.

## **X. EVIDENCE APPENDIX**

There has been no additional evidence submitted, entered by the Examiner, or relied upon by the Appellants in the present appeal.

## **XI. RELATED PROCEEDINGS APPENDIX**

There has been no proceedings or decision rendered by a court or the Board that relate to the present application.